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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/828,592	04/21/2004	Betty Shu Mercer	TI 36275	5550
23494	7590	08/26/2005	EXAMINER	
TEXAS INSTRUMENTS INCORPORATED P O BOX 655474, M/S 3999 DALLAS, TX 75265			FULK, STEVEN J	
			ART UNIT	PAPER NUMBER
			2891	

DATE MAILED: 08/26/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

AK

<b>Office Action Summary</b>	<b>Application No.</b>		<b>Applicant(s)</b>	
	10/828,592		MERCER ET AL.	
	<b>Examiner</b>		<b>Art Unit</b>	
	Steven J. Fulk		2891	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 11 August 2005.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) 11-15 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-10 and 16-20 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 21 April 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |   |   |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)             | 4) <input type="checkbox"/> Interview Summary (PTO-413)                     |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)    | Paper No(s)/Mail Date. _____  |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date _____   | 6) <input type="checkbox"/> Other: _____                                    |

**DETAILED ACTION**

***Election/Restrictions***

1. Applicant's election without traverse of Group II, claims 1-10 and 16-20, in the reply filed on August 11, 2005 is acknowledged.

***Claim Rejections - 35 USC § 103***

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1-6, 10, 16 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Datta '133 in view of Ashby et al. '238.

- a. Regarding claims 1-6 and 10, Datta teaches a method of manufacturing an interconnect for an integrated circuit comprising forming a surface conductive lead in an opening formed within a protective overcoat and over a barrier layer and seed layer, wherein the protective overcoat comprises layers of silicon nitride and polyimide or silicon oxide (col. 2, lines 57-65), the barrier layer is a tungsten titanium (TiW) barrier with a thickness of about 200 nm (col. 4, lines 1-3), and the seed layer is copper (col. 4, lines 8-15). The reference teaches subjecting the seed layer (col. 5, lines 58-63) and

barrier layer (col. 6, lines 43-49) to an etch process to remove the portions extending beyond the surface conductive lead.

Datta does not explicitly teach the use of a dry etch chemistry including carbon tetrafluoride and nitrous oxide, oxygen or chlorine to remove the portions of the TiW barrier layer. Ashby et al. teaches the use of carbon tetrafluoride in combination with nitrous oxide, oxygen or chlorine to etch the transition metal alloy of tungsten and titanium in the fabrication of integrated circuits (col. 4, lines 58-65; col. 6, lines 29-47).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use the dry etch gases of Ashby et al. to etch the TiW barrier layer of Datta because the combination of carbon tetrafluoride and nitrous oxide, oxygen or chlorine was a conventional dry etch chemistry for the removal of tungsten and titanium alloy barrier layers.

b. Regarding claims 16 and 20, Datta teaches all of the elements disclosed above in the discussion in view of Ashby et al., and further teaches fabricating several metallization layers of a microelectronic device in an integrated circuit (col. 1, lines 8-13, 29-35; col. 2, lines 47-54). The reference does not explicitly teach forming transistor

devices on the semiconductor substrate and interconnecting the transistors with one or more of the metallization layers.

However, it would have been obvious to one of ordinary skill in the art at the time the invention was made for the microelectronic device being connected by metallization layers of Datta to include transistor devices, as transistors were an integral part of a microelectronic device.

4. Claims 7, 8, 17 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Datta '133 in view of Ashby et al. '238 as described above, and further in view of Backus '124.

Datta teaches a method of etching the copper seed layer to remove the portions extending beyond the surface conductive lead. Datta does not explicitly teach using a wet etch of hydrogen peroxide and sulfuric acid to remove the seed layer. Backus teaches a method of etching copper to fabricated printed circuits using a etch chemistry including hydrogen peroxide and sulfuric acid (col. 2, lines 43-51). It would have been obvious to one of ordinary skill in the art at the time the invention was made to use the etch chemistry of Backus to etch the copper seed layer of Datta because hydrogen peroxide and sulfuric acid was a conventional solution for etching copper.

5. Claims 9 and 19 are is rejected under 35 U.S.C. 103(a) as being unpatentable over Datta '133 in view of Ashby et al. '238 as described above, and further in view of Homma et al. '752.

Datta teaches a method of forming a surface conductive lead, but does not teach the lead having a width ranging from about 3  $\mu\text{m}$  to about 200  $\mu\text{m}$ . Homma et al. teaches a method of forming a surface conductive lead having a width of about 100  $\mu\text{m}$  (col. 5, lines 51-57). It would have been obvious to one of ordinary skill in the art at the time the invention was made to form the surface conductive lead of Datta with a width as specified by Homma et al. because this was a conventional width for bond pads being used in a flip-chip or wire bonding process.

### ***Conclusion***

6. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

a. Srivastava et al. '457 discloses a method for manufacturing a surface conductive lead formed in the opening of a polyimide layer, comprising a TiW barrier layer, chromium/copper layer, and copper lead. A wet etch sequence including potassium sulfate, hydrogen peroxide and sulfuric acid is used to etch the chromium/copper layers and to slightly etch the TiW layer, and a RIE processes using carbon

tetrafluoride is used to completely remove the TiW layer extending beyond the copper lead.

b. Raskin et al. '633 and Efland et al. '275 disclose methods for manufacturing a surface conductive lead formed in the opening of a protective layer, comprising a TiW barrier layer, copper seed layer, and copper lead. A standard chemical etch as prescribed in compatible processing is used to remove portions of the barrier and seed layers extending beyond the copper lead.

c. Crank '974 discloses a method for manufacturing a surface conductive lead formed in the opening of a protective layer, comprising a tantalum or titanium nitride barrier, a copper seed layer and a copper conductive lead. The barrier layer is etched with carbon tetrafluoride to remove portions of the layer extending beyond the lead.

d. Fan et al. '771 discloses a method for manufacturing a surface conductive lead formed in the opening of passivation layers of silicon oxide, silicon nitride, and polyimide, comprising a barrier layer and a seed layer. The barrier and seed layers are etched using a standard RIE procedure to remove portions of the layers extending beyond the lead.

e. Tong et al. '128 discloses a method for manufacturing a surface conductive lead formed in the opening of a protective layer, comprising a TiW barrier layer and a wetting layer and a conductive lead. The barrier layer and wetting layer are etched using a sulfuric acid solution to remove portions of the layers extending beyond the lead.

f. Lee et al. '822 discloses a method for manufacturing a surface conductive lead formed in the opening of a protective layer, comprising a TiW barrier layer, a copper conductive lead, and a gold transition layer, which improves conductivity between the copper conductive lead and the solder bond packaging.

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Steven J. Fulk whose telephone number is (571) 272-8323. The examiner can normally be reached on Monday through Friday, 8:30am to 5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bill Baumeister can be reached on (571) 272-1722. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.



Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

sjf  
8/23/05

A handwritten signature in black ink, appearing to read 'B. William Baumeister', with a stylized, flowing script.

**B. WILLIAM BAUMEISTER  
SUPERVISORY PATENT EXAMINER**